esi® Engineering Bulletin
Electro Scientific Industries
7524 S. W. MACADAM AVE. • PORTLAND 19, OREGON

BRIDGES
AND
ACCESSORIES
no. 7

MARCH 1962
REPLACES JANUARY 1958

MEASURING THREE-TERMINAL CAPACITORS

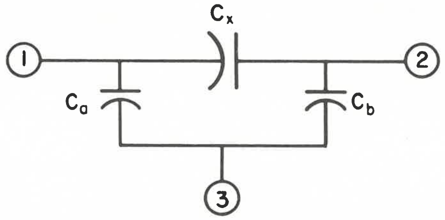

FIGURE 1.

A three-terminal capacitor is shown in Figure 1. C_x is the "direct" capacitance to be measured. C_a and C_b are "stray" capacitances whose effects are to be eliminated from the measurement.

ON ESI MODEL 250, 270 OR 290 BRIDGE

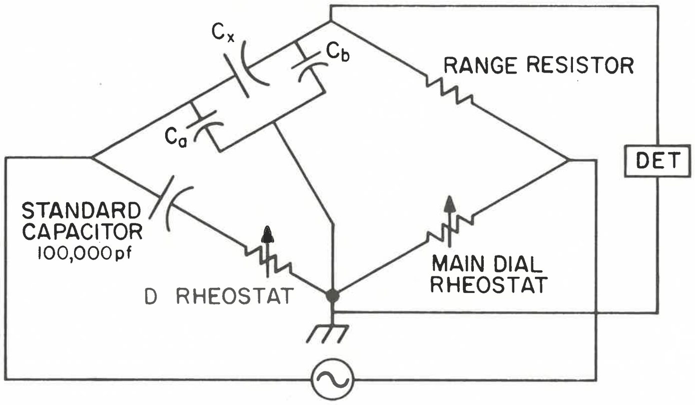

FIGURE 2.

Figure 2 shows the bridge connection normally used for measuring C_x.

Note that C_b is connected in parallel with the detector, where it can cause no error in the measurement. If C_b is very large, it may reduce the sensitivity of the detector.

C_a is connected in parallel with the 100,000 pf standard capacitor and "D" rheostat in the bridge. For normally low values of D, the rheostat resistance is only a few ohms; therefore, its effect is neglected in the following discussion.

If C_a is small, its effect can be neglected and the bridge reading can be used directly. For example, 100 pf at C_a will cause the bridge to read only 0.1% low.

© Copyright 1962 by Electro Scientific Industries, Inc.
LITHO IN U.S.A.

If C_a is too large to neglect, the resistance type bridge reading can be multiplied by a correction factor to obtain the actual value of C_x. When the value of C_a can be estimated or found to sufficient accuracy by a three terminal measurement, the procedure is as follows:

1. Connect the three-terminal capacitor as shown in Figure 2 and take a reading; call this reading C_1.
2. Estimate or measure the value of C_a.
3. Calculate the correction factor: $\left(1 + \frac{C_a}{100{,}000\ \text{pf}}\right)$
4. Multiply the reading C_1 by the correction factor; the answer is the value of C_x.

When the value of C_a cannot be estimated, the procedure is as follows:

1. Connect the three-terminal capacitor as shown in Figure 2, and take a reading; call this reading C_1.
2. Connect an additional capacitor C_y in parallel with C_x. C_y should be at least as large as C_x, and should not add appreciable stray capacitance in parallel with C_a. Take a reading, and call this reading C_2.
3. Remove the three-terminal capacitor, and take a reading on C_y alone.
4. Calculate the correction factor: $\left(\frac{C_y}{C_2 - C_1}\right)$
5. Multiply the reading C_1 by the correction factor; the answer is the value of C_x.

ON ESI MODEL 707 BRIDGE

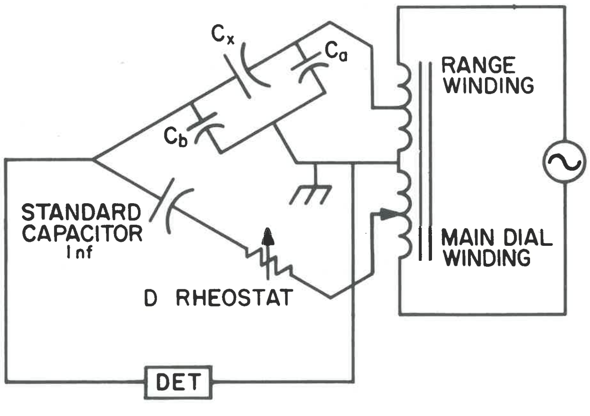

FIGURE 3.

Figure 3 shows the bridge connection normally used for measuring C_x.

Note that C_b is connected in parallel with the detector, where it can cause no error in the measurement. If C_b is very large, it may reduce the sensitivity of the detector.

C_a shunts the range winding and large values of C_a can be tolerated; 0.01µf will cause less than 0.01% change.